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The contribution of BAE Systems to the UK Economy

BAE Systems plays a key role in protecting people, national security, and keeping critical information and infrastructure secure. To quantify and qualify our contribution, we have again commissioned Oxford Economics to produce an independent analysis of our contribution to the economy of the UK.

This analysis shows that BAE Systems made an overall contribution of £9.3 billion to the UK's GDP in 2018, employing 124,000 people both directly and indirectly through a network of 6,000 companies with whom we spent £3.7 billion. Indeed, for every 100 jobs at BAE Systems, we supported 370 jobs in the economy as a whole.

In addition, last year, BAE Systems continued to showcase British technology, and our engineering and manufacturing capabilities overseas by exporting nearly £3 billion worth of goods and services from our UK businesses. Our desire to deliver advanced solutions with technical skill, efficiency and professionalism underpins our growing presence in multiple international markets. Our strong export record will continue through the considerable successes we achieved in international markets in 2018, with for example the Type 26 frigate which was selected by the Commonwealth of Australia for its Hunter Class nine-ship Future Frigate programme and is the design for Canada’s Surface Combatant programme.

In July 2018 we welcomed the UK’s Combat Air Strategy which will enable the UK government and industry to invest jointly in cutting-edge, next-generation combat air systems for the Royal Air Force and international partners. To support this strategy, the Tempest programme has been launched to work on proposals for a next-generation stealth combat jet to succeed Typhoon when it begins to leave service from 2040. Tempest represents exciting opportunities ahead for all those involved within the UK’s military aircraft sector as we consider completely new approaches to design and manufacture which can adapt to the technologies and customer requirements that will emerge as the design phase matures.

We continue to be a leading technology integrator and enabler in the UK and last year managed a £1.2 billion investment in R&D on behalf of customers and partners. We also maintained our position as the fourth-largest applicant with both the European Patent Office and the World Intellectual Property Organisation.

We manage significant R&D partnerships with UK universities and SMEs which focus on key areas of technology which are strategically important for our business, including autonomy, propulsion, virtual reality and advanced manufacturing. Here we are making great strides in accelerating technology application—for example, in cobotics in our aircraft manufacturing processes and in the development of augmented reality for the management of combat systems on naval ships.

Of course, evolving technologies and the fourth industrial revolution are already demanding new types of digital skills and aptitudes. In readiness for this we continue to invest significantly in skills—opening a new Academy for Skills and Knowledge in November 2018 for the development of submarine design and manufacturing skills for Dreadnought submarine production at Barrow-in-Furness. We also work closely with many national and regional organisations which strive to improve skills and business techniques for employers across the UK. Many of these partnerships are described in this report and include: “#ThisIsEngineering”, the multi-million pound STEM campaign coordinated by the Royal Academy of Engineering; Be the Business, which aims to improve productivity through leadership and employee empowerment; and Movement to Work, with whom we have worked to provide full-time employment for 120 young people who were previously not in employment, education or training.

I remain extraordinarily proud to be the Chairman of a company that plays such a crucial role in UK society, and is absolutely committed to serving the best defence and economic interests of our nation and allies across the world.

Sir Roger Carr
Chairman, BAE Systems plc
EXECUTIVE SUMMARY

124,000
Total number of UK full-time equivalent jobs supported by BAE Systems in 2018

For every 100 jobs at BAE Systems, a total of 370 jobs were supported across the UK economy

£9.3 bn
Total economic contribution to UK GDP made by BAE Systems in 2018

For every £100 from BAE Systems' own operations, a total of £330 was supported across the economy

£3.7 bn
Procurement spending by BAE Systems in 2018, with 6,000 suppliers across the UK

This spending supports a £3.0 billion contribution to GDP and nearly 50,000 jobs

BAE Systems is a global defence, aerospace, and security company with nearly 86,000 employees worldwide in 2018, with a major presence in the UK, the US, Saudi Arabia, and Australia.

BAE Systems is a major employer of professional engineers, scientists and technologists, and makes a considerable contribution to the UK economy through major operations in the air, land and sea defence sectors, as well as in the fields of electronics, intelligence and cyber-security.

The Company has sites spread widely across the UK, employing nearly 34,100 employees in 2018 and spending nearly £3.7 billion in the domestic supply chain.

In this report, we focus on the impact of BAE Systems’ UK operations within the UK in 2018. Firstly, we estimate the Company’s quantifiable impact on the UK’s GDP, employment, and tax revenues. Secondly, we discuss the wider, longer-term contributions that the Company makes to the UK through its capital investment, research and development spending, training programmes, and export sales.

THE TOTAL ECONOMIC IMPACT OF BAE SYSTEMS

We calculate that BAE Systems supported more than 124,000 full-time equivalent (FTE) jobs in the UK in 2018. This result is the sum of nearly 34,100 direct employees; nearly 50,000 workers supported by the Company’s supply chain spending; and more than 40,000 jobs supported by worker spending at consumer-facing businesses and in their value chains. This means that for every 100 direct jobs at BAE Systems in 2018, a total of 370 jobs were supported around the UK economy.

The Company is one of the UK’s largest employers of engineers, with two-thirds of its UK employees working in engineering-related roles. Directly employing nearly 34,100 UK FTEs, BAE Systems provides more than one percent of total UK manufacturing employment. Once the nearly 11,000 manufacturing sector jobs supported by the Company’s supply chain spending are included, BAE Systems supports 1.7 percent of all UK manufacturing jobs.

The Company’s operations contributed an overall total of £9.3 billion to the UK economy in 2018, with 6,000 suppliers across the UK. This figure comprises: more than £2.8 billion directly contributed by BAE Systems; a £5.0 billion impact through the value added by the Company’s supply chain spending; and an impact of more than £3.4 billion from worker spending. For every £100 contributed directly by BAE Systems’ operations, a total of £330 is contributed to the UK economy.

We find that BAE Systems generated £2.4 billion in tax revenues in 2018. This includes nearly £700 million paid directly by the Company, with the majority coming from employment-related taxes. The remaining £1.7 billion was contributed by the economic activity supported in BAE Systems’ supply chain, and by the induced impact of worker spending.

LONG-TERM BENEFITS FOR THE UK

As a technology-driven organisation, BAE Systems makes a significant contribution to the research and development (R&D) output of the UK. The Company has invested nearly £300 million in R&D funding in the UK over the past five years, and in 2018 alone carried out nearly £12 billion worth of R&D activity, including that funded by customers and partners. It is the UK’s fourth-largest applicant with both the European Patent Office and the World Intellectual Property Organisation.4

Thanks to this culture of innovation and capital expenditure of more than £200 million a year, worker productivity at BAE Systems is well above the UK average. We estimate the productivity level of each employee was £83,000 in 2018, 14 percent higher than the average for the UK manufacturing sector, and 27 percent above the average for the entire economy. A further contributor to high worker productivity is the training that BAE Systems provides: in the UK the Company has nearly 2,000 apprentices and 500 graduates on training schemes, and it recently opened its second Academy of Skills and Knowledge to provide additional training for its workforce.

In 2018, BAE Systems made nearly £3.0 billion of export sales. This is equivalent to nearly one percent of all UK goods exported that year. With key business wins for the design and build of nine ships for the Commonwealth of Australia’s Hunter Class Future Frigate programme, and the selection of the Type 26 design for the Canadian Surface Combatant Programme, BAE Systems looks set to continue being a major contributor to total UK exports in the years ahead.

BAE Systems itself funded £500 million in R&D over the past five years

£1.2 bn
Equivalent to nearly one percent of all UK goods exports in 2018

£3.0 bn
Export sales from BAE Systems’ UK operations

66%
The share of UK employees who work in engineering-related roles

Of the Company’s nearly 34,100 FTE employees, almost 2,000 are apprentices and 500 are on graduate training schemes

Based on Office for National Statistics Workforce Jobs by Industry release, June 2019.

4 BAE Systems spends £3.7 billion with UK suppliers. After accounting for economic “leakages” such as suppliers importing goods and services, this procurement spending results in a £3.0 billion contribution to GDP.

The Global Combat Ship is designed to provide a multi-role capability across a range of mission types, from anti-submarine warfare and air defence to humanitarian assistance. Its design employs a modular construction to facilitate through-life support and upgrades, as new technology comes on stream.

Production of the first UK variant—the Type 26 frigate HMS Glasgow—is well underway on the banks of the River Clyde in Glasgow, and construction of the second-in-class, HMS Cardiff, commenced in August 2019. The ships will replace the Royal Navy’s Type 23 frigates, with HMS Glasgow due for launch in the mid-2020s. The vessels will be built in two batches, with three in the current phase.

All eight of the frigates have now been named, with each taking inspiration from a different UK city, including Edinburgh, Sheffield, and Newcastle. The final completed ship is to be HMS London, with the entire order expected to sustain 1,700 jobs in Scotland for two decades.

Following a global competition, in 2018 the Royal Australian Navy awarded BAE Systems a contract for nine variants of the ship, to be known as Hunter Class frigates. These ships will be built in Adelaide by ASC Shipbuilding, which has become a subsidiary of BAE Systems in a move to revitalise Australia’s shipbuilding industry.

In February 2019 the Canadian government, together with Irving Shipbuilding, selected Lockheed Martin Canada, using BAE Systems’ Type 26 platform design, as subcontractor for the Canadian Surface Combatant programme. International endorsement by key partners has demonstrated that the Type 26 truly is a

Artist’s impression of the UK, Australian, and Canadian variants of the Global Combat Ship.
1. INTRODUCTION

BAE Systems commissioned Oxford Economics to carry out an assessment of the contribution that the Company made to the UK economy in 2018. In this report, we assess the size of BAE Systems’ impact in terms of GDP, employment supported, and its tax contributions.

To calculate BAE Systems’ total contribution to the UK economy, we consider the economic activity associated with the Company’s own operations, the activity supported by its procurement spending, and the impact of consumer spending by the employees of BAE Systems and the Company’s suppliers. For a more detailed explanation of this appraisal methodology, see overleaf.

As well as these quantitative macroeconomic impacts, we assess the other, less directly quantifiable channels through which BAE Systems creates value for the UK economy. This includes the Company’s technological advances resulting from R&D spending and partnerships with universities and industry, its training schemes for apprentices, graduates and other staff, and its work in engaging schoolchildren in engineering.

Our analysis is structured as follows:

- Chapter 2 calculates the number of jobs supported around the UK by the activity of BAE Systems;
- Chapter 3 assesses the Company’s impact on UK GDP;
- Chapter 4 quantifies BAE Systems’ contribution to the Exchequer in terms of tax revenues generated;
- Chapter 5 demonstrates the wider impacts that BAE Systems has on the UK economy; and
- Chapter 6 provides concluding remarks.

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- Chapter 6 provides concluding remarks.

BAE Systems’ work on emerging and experimental technologies is aided by its strategic partnerships with five UK universities: Birmingham; Manchester; Southampton; Strathclyde; and Cranfield—each chosen for their capabilities in important areas of research for the Company.

One such collaboration, with Cranfield University, focuses on “wire arc additive manufacturing” (WAAM). This process creates three-dimensional objects using robotically assisted electric welding equipment to melt metal wire, which is added layer by layer. It is estimated that WAAM can reduce costs by up to 70 percent, compared to the traditional approach of machining components down from solid materials, while also reducing lead times in the production process.*

The university’s WAAM team hit the headlines in 2016 by producing what is believed to be at the time the largest ever 3D-printed metal component—a six-metre long, 300kg beam made from aircraft-grade aluminium. Since then Cranfield University and BAE Systems have successfully tested WAAM to manufacture airframe structures out of titanium, while R&D work is under way for its use with steel and aluminium alloys. At the 2019 Additive Manufacturing in Space and Aerospace conference, a replica Typhoon component produced for BAE Systems using WAAM techniques was unveiled. The rear frame of the aircraft, built from 200 layers and measuring 1.5m by 2.5m, was built in partnership between Cranfield University and BAE Systems and is “equal to or better than current forgings”, according to the university.†

BAE Systems’ partnerships with UK universities also include working directly with doctoral students on experimental research. Every year the Company gives awards to PhD candidates from each of its partner universities for their contributions in a variety of fields, including long-range sensors, flight controls, and augmented reality. The winner of this year’s prize was Gier Olafsson, University of Southampton (pictured) for his work on non-destructive evaluation of composite to steel joints in marine environments.

“I’m really proud to have been nominated for the award, let alone win it,” said Gier. “The support I have had from BAE Systems has been brilliant. Right from the start I’ve had access to people, expertise and facilities to help me carry out my research. I think the fact this is an industrially relevant project is just fantastic.” Gier’s PhD Supervisor, Professor Janice Barton from the Department of Mechanical Engineering at the University of Southampton, added: “Gier’s PhD will contribute to more sustainable shipping with impacts across the commercial sector, as well as in naval applications, by providing more lightweight and durable alternatives to conventional ship construction.”

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* Cranfield University press release (number PR-Corp-16-69), 7th October 2016, “Is this the largest metal 3D part ever made?”
† ibid.
AN INTRODUCTION TO OUR ECONOMIC IMPACT ANALYSIS

The full impact of BAE Systems on the UK economy is assessed using a standard means of analysis called an economic impact assessment. This involves quantifying the Company’s total impact on the UK across three “core” channels:

- **Direct impact**—relating to BAE Systems’ own UK activities, this encompasses the economic activity, taxes, and employment supported directly by the Company.
- **Indirect impact**—this encapsulates the economic activity, taxes, and employment supported in the UK supply chains of BAE Systems’ UK sites, as a result of their procurement of goods and services from other firms. Note: this channel includes the impact of the Company’s capital investments, such as on new facilities and IT equipment, as well as that of its day-to-day purchases.
- **Induced impact**—this comprises the wider economic benefits that arise when BAE Systems’ employees in the UK, and those in the Company’s UK supply chains, spend their earnings—for example, in local retail and leisure establishments.

This approach enables us to build a picture of BAE Systems’ overall contribution to the UK economy across three key metrics:

- **Economic contribution**—or more specifically, BAE Systems’ “gross value added” (GVA) contribution to GDP. In simple terms, GVA is the Company’s revenue minus its procurement costs, or “intermediate consumption” in economic parlance. For brevity, we refer to this as the “economic contribution” throughout the report.
- **Employment**—measured on a full-time equivalent basis.
- **Government revenues**—including income tax, corporation tax, business rates, and National Insurance contributions.

Alongside these core economic impacts, we also consider the wider “catalytic” economic impacts through which BAE Systems contributes to the UK’s long-term prosperity. These catalytic effects correspond to a number of the themes identified in recent government publications, such as export growth, skills development, and building future capabilities through R&D.

The modelling upon which this report is based computes the economic footprint of BAE Systems in the UK for 2018. Our approach uses financial data for that year from BAE Systems’ own accounts, plus the latest economic data available at the time of writing.

Fig. 1 (right) presents a schematic diagram of our Economic Impact Analysis model. Additional information on our modelling approach is provided in this report’s appendix.
BAE Systems is playing a leading role integrating the F-35B aircraft with the Queen Elizabeth Class Aircraft Carriers.
2. EMPLOYMENT CONTRIBUTIONS

In this chapter, we discuss the high-value jobs supported by BAE Systems around the UK in 2018. The Company supports jobs in three ways: through its direct employees; through the indirect impact of the workers employed as a result of the Company’s supply chain spending; and through those with jobs supported by the consumer spending of the Company’s workers and of those in its supply chain. All employment figures presented here are in full-time equivalent (FTE) terms unless otherwise stated.

2.1 TOTAL EMPLOYMENT CONTRIBUTION

BAE Systems’ economic activity in the UK supported a total of more than 124,000 FTE jobs in 2018. The Company itself employed nearly 34,100 FTE workers in 2018 at its locations around the country. This means that for every hundred workers employed directly by BAE Systems, a total of 370 jobs were supported in the UK.

The Company also supported 49,000 jobs along the value chain, as suppliers employed workers to produce the goods and services purchased by BAE Systems. Finally, 42,000 jobs were supported through employees of BAE Systems, and those in its supply chain, spending their wages in consumer-facing businesses, as these companies employed staff and made further purchases along their own value chains.

Fig. 2: BAE Systems’ contribution to UK employment, 2018

Source: Oxford Economics. Totals may not sum due to rounding.

This includes those working for BAE Systems Incorporated, the US subsidiary of BAE Systems, at UK sites such as Rochester.
2.2 BAE SYSTEMS' DIRECT EMPLOYMENT

BAE Systems directly employed nearly 34,100 workers in full-time equivalent (FTE) jobs in the UK in 2018. This is 40 percent of the Company’s global workforce and is equivalent to more than one percent of total UK manufacturing employment.*

Two-thirds (66 percent) of BAE Systems’ UK employees work in engineering roles or engineering-related roles, across disciplines including flight operations; software and systems design; mechanical, electrical, and structural engineering; as well as aircraft and naval ship maintenance and manufacturing.

An additional 11,500 FTEs, or 34 percent, work in occupations unrelated to engineering, including management roles and functional and professional positions.

2.3 SKILLS BASE

The skills of BAE Systems’ employees help the UK maintain its sovereign defence industrial capabilities. The Company takes this responsibility very seriously—investing approximately £90m per year in education outreach, early careers activity, and retraining and upskilling for existing UK employees.

In 2018, 2,000 apprentices were in training with BAE Systems in the UK. In addition in 2018 nearly 500 employees took part in BAE Systems’ graduate programme. 60 participated in a year-long industrial placement programme as part of a degree course, and more than 100 young people took part in 12-week summer internships.

BAE Systems is also involved with many initiatives to develop industrial skills and boost the technological and production capabilities of the UK, including the North West pilot scheme of ‘Made Smarter’. Backed by £20 million of government funding, this programme is designed to engage with 3,000 of the region’s small and medium-sized manufacturers in a bid to help them adopt more digital technologies and boost productivity. Research by the initiative’s organisers suggests this could add £115m to the North West economy.

Based on Office for National Statistics Workforce Jobs by Industry release, June 2019.
BAE Systems is a leading member of Movement to Work (MtW), the UK’s largest employer-led collaboration aimed at reducing unemployment for those aged 18-30 and not in education, employment or training. The programme consists of two weeks of confidence-building activities and skills training with the Prince’s Trust, including CV writing and interview advice, followed by a two-week work placement at a BAE Systems facility.

“The work I was given in the two weeks was really tangible,” says Anastacia (pictured), a past MtW participant of the BAE Systems programme. “It really got us involved with a lot that’s going on in the business.”

According to Adam Withenshaw, a mentor on the scheme from BAE Systems’ Air business: “The factor that I enjoy most about this programme is the rapid and significant change you can see in some of the young people.”

The Company offers 98 placements a year, with 497 young people having completed MtW since 2014. More than one third of these went on to employment within BAE Systems, with 118 becoming apprentices and one joining the graduate scheme. The Company has contributed £676,000 to the scheme since 2014 and has committed a further £294,000 for 2019 and 2020.

In return, MtW offers cost efficiencies for participating companies. BAE Systems estimates the cost of recruiting an apprentice who has been through the programme is roughly half that of the typical recruitment process. The scheme has also helped to boost interest in STEM (science, technology, engineering and mathematics) careers among under-represented groups. The structure of MtW has also encouraged more women to explore a career in engineering.

BAE Systems’ second Academy for Skills and Knowledge (ASK, pictured) was opened in Cumbria in November 2018. The academy represents a £25m investment by BAE Systems to develop the engineering skills needed for delivering complex Royal Navy submarine programmes.

Located at the Company’s Barrow-in-Furness shipyard, where work is also underway on the new Dreadnought-class ballistic missile submarine, the ASK includes classrooms, workshops, scale models of submarine units, and a virtual reality suite where employees can train before working on the real thing.

More than 1,500 BAE Systems employees are expected to use the Barrow ASK each month, including many of its 700 apprentices. The new ASK will be a vital part of the Dreadnought Programme will be a vital part of the Dreadnought programme as, alongside its industry partners, BAE Systems upskills and maintains its workforce.

The first ASK—opened in Samlesbury, Lancashire, in December 2016—trains employees of all experience levels in BAE Systems’ Air business. This £15.6 million facility includes a full-size Hawk trainer jet, to familiarise workers with an aircraft used by airforces around the world, and a carbon-fibre “cleanroom”, to introduce trainees to materials used in the Typhoon aircraft.

More than 100,000 people have attended the Samlesbury ASK in its first two years of operation—including more than 1,500 apprentices, graduates, and air cadets, plus some 5,000 young people on educational visits.

Other recent notable BAE Systems investments in employee development include the RJ Mitchell Aircraft Maintenance Academy (AMA) at North Humberside Airport. Named in honour of the designer of the Spitfire fighter aircraft, this £5 million facility was opened in 2015 to build a steady flow of qualified aircraft maintainers each year. Apprentices joining the Company’s two year programme spend 12 months at the AMA, acquiring hands-on experience while also completing Civil Aviation Authority approved and City & Guilds accredited aircraft maintenance training.

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The contribution of BAE Systems to the UK Economy

2.4 SUPPLY CHAIN CONTRIBUTION TO EMPLOYMENT

The employment impact of BAE Systems in the UK extends well beyond its own direct hires. The Company’s UK sites also make significant purchases from UK suppliers—£3.7 billion worth in 2018. This domestic supply chain activity stimulates economic activity at a wide range of companies, particularly in high-tech sectors such as high-tech manufacturing and engineering consultancy. Altogether, we estimate that this procurement activity supported a further 49,000 jobs along the supply chain in 2018. This includes more than 3,000 contractors employed by BAE Systems as part of its procurement spending, three-quarters of whom are engineers or in engineering-related roles, with the remainder in professional roles or other functions.

To estimate the total indirect impact, we used spending data from BAE Systems split by category of purchase in our economic impact model, which is based on the UK national accounting framework. The model first traces how many jobs are created on average in each industry based on revenue for the supplier. The model then looks at where each supplier makes their own purchases, and how many jobs are supported as a result. This process is followed iteratively until the ripples in the economy from the initial injection are too small to measure.

BAE Systems’ supply chain spending reaches almost all of the UK’s approximately 400 local authority districts, local government districts, and council areas. However, as Fig. 6 illustrates, much of the spending is concentrated around the south and north west of England, as well as Scotland.

The indirect employment impact from BAE Systems’ procurement spending impacts many sectors of the UK economy, with the largest effects seen in administrative services, manufacturing and professional services, with 11,900, 10,900 and 10,600 jobs respectively. The large impact felt in the manufacturing sector reflects the significant amount of procurement spending that BAE Systems makes in the industry, such as the major purchases of engines for naval ships.

Professional services sees a large number of indirect jobs supported in part due to BAE Systems hiring a large number of engineers as contractors, which are included in this sector, as well as significant spending on IT and management consultancy.

Fig. 5: Indirect employment contribution by industry, 2018

Source: Oxford Economics

Fig. 6: BAE Systems’ total procurement spending within each local authority district, 2018

Source: Oxford Economics, BAE Systems
The contribution of BAE Systems to the UK Economy

2.5 EMPLOYMENT SUPPORTED BY WORKER SPENDING

Beyond the direct employees of BAE Systems and those supported by its supply chain spending, further jobs are supported through the impact of wage spending. Wages paid to the Company’s employees and the workers in its supply chain stimulate household spending, with impacts felt in consumer-facing sectors such as leisure and retail, as well as power, transport, health and education. This supports further jobs in these sectors, as well as those in their subsequent supply chains.

We estimate that this induced employment impact of BAE Systems supported 42,000 jobs in 2018, with the largest effect in the retail & wholesale sector at more than 10,000 jobs. A further 6,000 jobs were supported in the next largest sector, the accommodation and food services industry.

This estimate is reached using the total amount of employee compensation paid by BAE Systems to its workers and the sums paid to contractors, plus the estimated earnings of the workforce in the Company’s UK supply chain. Using macroeconomic data on average spending patterns in the UK, our model allocates this spending to different industries, and then traces the impact of the supply chain spending of these sectors.

We estimate that this could add £115m to the North West economy.

BAE Systems is also involved with many initiatives to develop industrial skills and boost the technological and production capabilities of the UK, including the ‘Made Smarter’ pilot scheme. Backed by £20 million of government funding, the programme is designed to engage with 3,000 of the region’s small and medium-sized manufacturers in a bid to help them adopt more digital technologies and boost productivity. Research by the initiative’s organisers suggests this could add £115m to the North West economy.

Fig. 7: Induced employment contribution by industry, 2018

In preparation for the low-cost, rapid and flexible manufacturing activity that is expected to be required in the future, BAE Systems engineers at the Company’s aircraft manufacturing facility in Warton, Lancashire are trialling a new “cobotic” workstation (pictured). The workstation is part of the Air Works Factory of the Future project at Warton and uses robotic technologies that could support and enhance the building of complex combat aircraft and enable workers to delegate repetitive, machine-driven tasks requiring accuracy and consistency to the workstation’s collaborative robot (or “cobot”) arm. The project was developed in collaboration with researchers from the University of Sheffield’s Advanced Manufacturing Research Centre, as part of its Factory 2050 programme.

In addition to the operator giving tasks to the cobot arm, the workstation provides guidance to the user, based on individual skills profiles programmed into it. These allow the machine to deliver cues and instructions tailored to each user’s level of expertise, such as “pick by light” technology that prompts workers to select the correct components.

An industrialised version of the Collaborative Workstation has been deployed on the Typhoon jet production line at the Company’s nearby Samlesbury site, and is expected to increase productivity levels by facilitating the presentation of engineering data for new team members and through digitally enabled error detection. Data collected by software built into the workstations will also enable engineers to analyse and further improve this high-tech collaborative technology.

* Siemens press release, 17th December 2018, “North West to Usher In UK’s Next Industrial Revolution With £20m ‘Made Smarter’ Programme”.

Source: Oxford Economics
Launched in summer 2018 in partnership with organisations including the CBI and Microsoft, ‘The Intelligence Network’ is BAE Systems’ commitment to engage and activate a global community of cyber, security and business leaders in the fight against cyber-crime. Less than a year later, the network boasts approximately 1,800 members spanning technology, retail and finance organisations. More than half of these members hail from the UK and more than a quarter from the US, and the cohort includes many cyber- and financial-crime prevention professionals.

Cyber-security is a large and growing global problem. In 2018, it is understood that there were more than 53,000 incidents relating to cyber-security around the world, including more than 2,200 data breaches—up from around 42,000 incidents the previous year. Half of these breaches are reported to have been carried out by criminal groups, with a further 28 percent by actors inside the businesses, and 12 percent identified as “state-affiliated”.

According to BAE Systems’ threat intelligence research, cyber-criminals often share techniques and malicious code including malware to maximise the disruption they cause. However, the organisations defending against threats typically operate with less co-operation and with different levels of security investment, meaning many are ill-equipped to deal with sophisticated threats. This situation triggered the team at BAE Systems to seek a solution by establishing “The Intelligence Network”.

To better understand how to tackle cyber-fraud, the Network runs workshops and focus groups for its members, as well as carrying out quantitative research. The organisation aims to create actionable approaches, standards, structures and blueprints to serve the business community in the fight against cyber-crime, as well as to influence changes in policy and regulation.

3. GDP CONTRIBUTIONS

In this chapter, we assess how BAE Systems’ economic activity contributed to UK GDP in 2018. Impacts are generated by the Company’s own business operations, plus the operations of its suppliers and the economic activity supported by the wage-related consumer spending of BAE Systems and supply chain workers.

3.1 TOTAL ECONOMIC CONTRIBUTION

BAE Systems’ business activity in the UK contributed a total of £9.3 billion in gross value added to the national economy in 2018. Within this figure, more than £2.8 billion results directly from the Company’s own domestic operations, including the activities of BAE Systems’ businesses operating at UK sites which are managed by overseas-based BAE Systems businesses. A further £3.0 billion was contributed by the knock-on economic impact of the Company’s £3.7 billion in supply chain spending. Lastly, more than £3.4 billion was contributed by the activity supported by the wage spending of BAE Systems’ employees, contractors, and workers in the supply chain.

These figures mean that for every £100 of GVA generated directly by BAE Systems, a total of £330 of economic activity was supported across the economy as a whole in 2018. The Company is therefore said to have a GVA “multiplier” of 3.3.

Fig. 8: BAE Systems’ contribution to UK economy, 2018

Source: Oxford Economics. Totals may not sum due to rounding.

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The contribution of BAE Systems to the UK Economy

3.2 BAE SYSTEMS’ DIRECT CONTRIBUTION TO GDP

BAE Systems realised £7.3 billion of revenues in 2018 from its operations in the UK. The vast majority of revenues were generated by BAE Systems’ defence operations, with £400 million generated by commercial aerospace activities.

To generate this revenue, the Company purchased £3.7 billion of goods and services from approximately 6,000 UK suppliers, plus a further £760 million of imports from overseas suppliers. Using the “production approach” to estimating economic contribution, which is revenue minus the cost of procurement inputs, we calculate that BAE Systems made a £2.8 billion contribution in gross value added terms to the UK economy in 2018.

With nearly 34,100 direct employees, this equates to average productivity of nearly £83,000 per worker. This is 14 percent higher than the average for the UK manufacturing sector and 27 percent higher than the overall average for the UK in 2018. This reflects BAE Systems’ highly-skilled employees, the capital-intensive nature of the products the Company produces, as well as the large amount of research and development spending.

3.3 SUPPLY CHAIN CONTRIBUTION TO GDP

As detailed, BAE Systems’ operations in the UK spent £3.7 billion with UK suppliers in 2018, helping to support business activity across all sectors of the economy. The largest category of procurement spending for BAE Systems in 2018 included payments made to major subcontractors for large components for capital projects such as building Royal Navy vessels. Other significant areas of spending included IT, engineering and business consultancy, as well as facilities management and refurbishment.

Overall, this procurement spending is estimated to have generated a total of £3.0 billion in gross value added activity through the supply chain. Due to the pattern of spending, the sectors with the largest indirect GVA impacts are manufacturing and professional services, with nearly £900 million and £650 million respectively—the latter includes the wages of engineers hired as contractors by BAE Systems.

**Fig. 10: Breakdown of economic activity supported by BAE Systems’ supply chain spending, 2018**

Overall, BAE Systems’ £3.0 billion contribution to UK GDP through its supply chain is less than the Company’s £3.7 billion total procurement spend due to imports of goods and services purchased by businesses along the supply chain. These imports are economic “leakages” and do not contribute to UK GDP.
3.4 GDP SUPPORTED BY WORKER SPENDING

The wages paid to BAE Systems’ employees, contractors and employees in the Company’s UK supply chain provide an additional stimulus to the UK economy through consumer spending. This expenditure is estimated to have supported £3.4 billion in economic activity in the UK in 2018.

The distribution of this impact reflects where households typically spend their money in the economy, and as such is focused around consumer-facing industries. The largest effect is a nearly £1.0 billion impact in the real estate sector, followed by more than £500 million in the retail sector as workers spend their money in local shops.

Fig. 11: Breakdown of induced economic activity, 2018

Source: Oxford Economics.
The origins of BAE Systems’ munitions business can be found in the establishment of the Royal Ordnance by King Henry VIII. Today, the munitions business employs approximately 1,130 people at sites in Glascoed, South Wales, Washington in Tyne and Wear, and at Radway Green in Cheshire.

One recent example of new technology developed by BAE Systems and Nexter, working together in the CTai joint venture, is the 40mm Cased Telescope Cannon (CT40), which delivers rounds with up to four times the firepower of its 30mm predecessors. CT-40 is more compact, leaving extra room for equipment and crew inside the vehicle, and is less complicated mechanically as there are no belts or links to wear, and at Radway Green in Cheshire.

BAE Systems also produces more than 60,000 rounds per year of different CT40 ammunition types.

BAE Systems has invested £2.6 million in a new factory at Glascoed, which is set for completion by the end of 2019, ready to produce its first rounds in 2020. It is expected to manufacture more than 60,000 rounds per year of different CT40 ammunition types.

To support the manufacture of ammunition for CT40, BAE Systems has recently introduced a precision manufacturer of parts for mortars, shells and medium-calibre ammunition. This company has recently contributed machining and design skills from its 48-strong workforce to the CT40 ammunition production process.

Another small UK supplier—Gordano Support Group—ensures that BAE Systems’ munitions arrive at the customer in a safe and protected state. Employing 126 people, Gordano provides logistics and packaging solutions which protect a multitude of items, including munitions, of all shapes, sizes and complexity in all environments. Operating from seven locations throughout the UK, and support hubs in the US and Europe, Gordano also provides expert knowledge and consultancy services on defence and military packaging standards.

The contribution of BAE Systems to the UK Economy

ABBE Systems invests around £90 million each year in skills and educational activities. The Company attends careers fairs across the country and runs initiatives to highlight the importance of STEM (science, technology, engineering and mathematics) subjects to young people.

One such activity is BAE Systems’ annual Schools Roadshow, run in association with the Royal Navy and Royal Air Force. The Roadshow aims to visit more than 400 schools through the country each year, introducing students to the science behind mobile phones, Bluetooth and radar.

Another programme is the nationwide awareness campaign, “#ThisIsEngineering”, created in January 2018 in response to the UK’s need for more engineering talent. Figures from EngineeringUK suggest the country’s annual shortfall could be as many as 59,000 engineering graduates and technicians.

Led by the Royal Academy of Engineering and supported by BAE Systems, “#ThisIsEngineering” features a series of films portraying young engineers working in industries ranging from blockbuster films to disaster relief. The films have been viewed more than 18 million times on social media, predominantly by teenagers, with equal engagement from boys and girls. A survey of 1,200 GCSE and A-level students following the first year of the campaign revealed that consideration of engineering as a career option had almost doubled among those teenagers surveyed, from 39 to 72 percent.

For older students, the Royal Academy runs the Graduate Engineering Engagement Programme (GEEP) in partnership with SEO London, a non-profit organisation which helps to prepare degree students and graduates from ethnic minority or lower income backgrounds for career success. GEEP is a collaborative employer programme to ease the transition of engineering graduates from diverse backgrounds into engineering employment, and has recently won the Race Equality Award at Business in the Community’s Responsible Business Awards 2019.

BAE Systems is one of 16 engineering employers involved with GEEP, which launched in mid-2018 following a three-year pilot. During this phase, employers engaged with more than 450 engineering undergraduates and recent graduates, of which more than 90 percent were from ethnic minorities, 30 percent were female, and more than three-quarters were from the newer post-92 universities or from socioeconomically disadvantaged backgrounds.

The final GEEP event of 2018 was hosted by BAE Systems at the Academy for Skills and Knowledge in Samlesbury. This event, the first to have been held in the North West of England, offered attendees the chance to network with employees from BAE Systems and other renowned engineering firms, participate in interactive workshops, and attend panel discussions and presentations.

The contribution of BAE Systems to the UK Economy
BAE Systems is part of the Dreadnought Alliance with the UK Ministry of Defence's Submarine Delivery Agency and Rolls-Royce. BAE Systems undertakes design activity for the whole boat platform and combat system and will build the four Dreadnought Class boats.
4. TAX CONTRIBUTIONS

The economic contribution that BAE Systems makes to the UK economy discussed in the previous sections includes generating a significant amount of tax revenues, which are used to finance essential public services.

In this chapter, we estimate the total tax contribution that the Company makes to the UK public finances. These taxes come in the form of corporation tax, taxes associated with employment, and others such as the Apprenticeship Levy, customs duties, and environmental taxes. Taxes are generated by the Company itself, its supply chain and through the spending of workers at BAE Systems and in its supply chain.

4.1 TOTAL TAX CONTRIBUTION

Nearly £2.4 billion of tax revenue was generated by BAE Systems’ operational activities in the UK in 2018. This is roughly equivalent to the Foreign and Commonwealth Office’s 2018-19 departmental budget. The largest individual component of this total was the £1.0 billion induced tax contribution, which is generated by the wage-financed spending of the staff of the Company and its supply chain and, as such, is boosted by the inclusion of the VAT paid by consumers.

The next-largest component is the indirect impact, at approximately £700 million in 2018. This represents the taxes paid by the companies in BAE Systems’ supply chain, and includes their corporation tax, workforce-rated taxes such as National Insurance Contributions and their employees’ income tax and other taxes on production such as business rates. BAE Systems itself directly contributed nearly £700 million to the public finances in 2018.

Fig. 12: BAE Systems’ total tax contribution in the UK, 2018

Source: Oxford Economics. Totals may not sum due to rounding.

<table>
<thead>
<tr>
<th>Component</th>
<th>£, billions</th>
</tr>
</thead>
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<td>Direct Indirect</td>
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</tr>
<tr>
<td>Induced</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>2.4</td>
</tr>
</tbody>
</table>

4.2 BAE SYSTEMS’ DIRECT TAX CONTRIBUTION

The nearly £700 million in tax revenue that BAE Systems generated directly is roughly equivalent to the combined 2018-19 departmental budgets of the Cabinet Office and Department for International Trade.

The majority of this figure came from employment-related taxes—nearly half (44 percent or £300 million) came from the income taxes of the Company’s employees alone. A further 43 percent, or £290 million, was paid as Employer and Employee National Insurance Contributions.

The Company generated £70 million in Corporation Tax in 2018, while the Apprenticeship Levy was nearly £8 million. The remaining tax contributions came from environmental taxes such as the climate change levy and the carbon reduction commitment, as well as insurance premium taxes and customs duties.

Fig. 13: BAE Systems’ direct tax contribution by type, 2018

Source: Oxford Economics. Totals may not sum due to rounding.

- Income Tax: £300 million
- Corporation Tax: £70 million
- Employer NICs: £120 million
- Employee NICs: £170 million
- Other Taxes: £70 million
- £, millions

**Note:** HM Treasury Public Expenditure Statistical Analyses 2018, Table 1.4.
Team Tempest: Maintaining the UK’s Combat Air Capability

The UK Government’s Combat Air Strategy of July 2018 states that a strong sovereign combat air sector is essential to delivering the freedom of action and operational advantage that allows the UK to decide how and when to defend the country and national interests. The Strategy was clear that the Royal Air Force, underpinned by a world-leading industrial capability, is critical to the UK’s ability to deliver national security and support the Government’s vision of a prosperous, influential and global Britain. In order to sustain this position, the Strategy initiated a number of actions including the establishment of Team Tempest—a partnership between military and industry to develop the technologies and skills to ensure that the UK remains at the forefront of global combat air capability.

BAE Systems brings its capabilities in the design, development, manufacture and support of advanced combat air systems to the Team Tempest partnership, which includes the Ministry of Defence, Rolls-Royce, Leonardo UK and MBDA UK. The aim of the Team is to ensure that the UK can lead the design and development of a Future Combat Air System (FCAS), which could replace the capabilities currently provided by the Typhoon as it begins to leave service from 2040.

An FCAS will have to operate in conjunction with a wide range of other civil and military equipment across land, sea, air and cyber domains, including unmanned systems. Operators will have the ability to rapidly adapt the aircraft system to perform new functions or change its performance to ensure it can meet a changing threat environment. Advanced manufacturing techniques will also play a significant role in reducing the unit production cost of future combat aircraft. For example, service costs can be reduced by using robotics adapted from manufacturing to re-fuel, re-arm, repair, and adapt.

In an early success in securing international collaboration, Sweden and the UK announced in July 2019 an agreement to collaborate on a joint combat air development and acquisition programme, including the development of new concepts to meet both nations’ future requirements.

Furthermore, in September 2019, BAE Systems, Leonardo UK, Rolls-Royce and MBDA UK, together with key Italian industry players Leonardo Italy, Elettronica, Avio Aero and MBDA Italy, announced their intent to partner on the Tempest programme by signing a Statement of Intent. The signatories said they will work together to define an innovative concept and partnership model which will include knowledge sharing, product definition and technology development for the joint development of future combat air systems.

BAE Systems adds significant value to the UK economy not only through the economic activity and employment supported by its day-to-day operations, but also significantly through exports and in the development of new, highly advanced technologies with a network of suppliers, SMEs, and universities. In this chapter, we examine these broader economic benefits that BAE Systems contributes to the UK.

5.1 Research and Development

An important channel through which BAE Systems enhances the UK economy is through the research and development work the Company performs. BAE Systems has self-funded nearly £500 million of R&D work over the past five years, including more than £90 million in 2018 alone.

However, the total annual value of the R&D investment carried out by BAE Systems in the UK, including that funded by customers and partners, reached £1.2 billion in 2018, up from £700 million five years previously.

The Company’s significant R&D work resulted in BAE Systems being the UK’s fourth-largest patent applicant with both the European Patent Office in 2018 and the World Intellectual Property Organisation in 2017. Overall, there are nearly 2,200 patents granted worldwide related to innovations at BAE Systems’ UK businesses, with more than 1,300 separate inventions covered by patents or patent applications.

Harnessing and exploiting technological capability across BAE Systems’ global business is a priority for the organisation. In 2017, the role of Chief Technology Officer was created to ensure the Company can access the key technologies it requires now and in the future, through investment and strategic partnerships. The CTO ensures BAE Systems maintains capabilities in strategically important technology areas such as autonomy, machine learning, hypersonics, and advanced manufacturing.

Examples of innovations developed by BAE Systems and its partners are described in the case studies throughout this report. These include introducing new processes and equipment such as collaborative robots for aircraft manufacturing and 3D printing with metal, as well as more widely-applicable developments in areas such as augmented- and virtual-reality systems.

Fig. 14: Total annual value of R&D activity carried out by BAE Systems

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[Source: BAE Systems](https://www.baesystems.com)

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European Patent Office Annual reports and statistics.


This chart includes the value of both self-funded and customer- and partner-funded R&D work carried out by BAE Systems.
5.2 CAPITAL INVESTMENT

BAE Systems invested £244 million of capital spending in the UK in 2018, and more than £1 billion in the five years since 2014, including building facilities and machinery that increase BAE Systems’ productive capacity and the capital stock of the UK.

The benefits of this investment extend far beyond the year in which the expenditure takes place, helping to boost the economic prospects of the UK for years to come by raising worker productivity. Productivity is, in turn, an important element determining the long-term growth of UK living standards and as the Bank of England notes, it’s private businesses that “are vital for driving productivity” increases.*

Major capital investments carried out by BAE Systems in 2018 included completion of the £25 million Academy of Skills and Knowledge at Barrow-in-Furness, Cumbria. This facility will support decades of skills training in submarine design and building.

Additional investment was approved by the UK’s Ministry of Defence for major transformation work at the BAE Systems Barrow-in-Furness site to support the delivery of the Dreadnought submarine programme. This includes refurbishment of the site’s main manufacturing facility, adding a new 28,000 square metre logistics facility to store submarine parts and materials within the local area, and a new central yard complex with two new major buildings.

A further example of ongoing capital investment includes the Naval Ships business, which is investing approximately £30 million in its Glasgow shipbuilding operation. This includes the installation of equipment, such as robotic welders, pipe bending machinery and a new lathe, completed in early 2019.

Other capital expenditure in 2018 included £68 million by the Company’s Air business on programmes such as upgrading its carbon fibre manufacturing equipment.

5.3 EXPORTS

The UK operations of BAE Systems made nearly £3 billion of export sales in 2018, equivalent to nearly one percent of UK goods exports that year. Generating exports is an important economic contribution to the UK as it helps to boost growth by increasing demand for the country’s goods and services, which in turn supports jobs and tax contributions. In addition, working with other governments to deliver defence products helps to foster closer strategic relationships between the UK and partner countries.

In 2018, the UK government set a long-term ambition to increase exports as a share of UK GDP to 35 percent, up from 30 percent in 2017. As BAE Systems’ £3 billion of exports are approximately equal to 100 percent of its direct contribution to GDP, the Company provides the UK with a significant boost towards this target.**

Small boats produced by BAE Systems are used by armed forces and governments in more than 40 countries around the world. In September 2019, the Company was awarded UK-government contracts to maintain and support more than 850 small boats that help protect Britain’s shores.
EMBRACING ‘OPEN INNOVATION’—COLLABORATIONS WITH SMES

In the last two decades a number of disruptive technologies including the rapid development of artificial intelligence, machine learning, 3D printing and mobile communications has required the defence sector and BAE Systems to work more collaboratively with external organisations to harness emerging technologies and jointly retain a competitive edge. This approach to sharing innovation and technologies is led by its Chief Technology Officer and results in partnerships with small and medium-sized enterprises (SMEs) throughout the UK.

Notable recent examples include joint engineering work to develop an unmanned aerial vehicle (PHASA-35, pictured) with Hampshire-based company Prismatic, which BAE Systems announced in September 2019 it would be acquiring. The aircraft’s lightweight build and 35 metre wingspan, solar cells, and long-life battery technology should enable it to fly continuously at high altitude for up to 12 months at a time, using the sun during the day to power it and recharge its batteries for continued operation overnight. Test flights are planned for 2020.

BAE Systems is also a shareholder in Reaction Engines, and is working with the organisation to develop the Synergetic Air-Breathing Rocket Engine (SABRE), a new class of power unit that aims to change the economics of hypersonic flight. The engine is designed to enable aircraft to fly in “air-breathing mode” within the Earth’s atmosphere at more than five times the speed of sound, before switching to “rocket mode” that allows space flight at up to orbital velocity (equivalent to 25 times the speed of sound).

In April 2019, Reaction Engine’s innovative rapid cooling technology was successfully tested—the first stage of trials that will eventually expose SABRE’s pre-cooler equipment to the 1,000°C air temperature expected at Mach 5. Further tests of the main engine core and critical subsystems will be carried out at Reaction Engines’ new purpose-built test facility at Westcott, Buckinghamshire. This will be a crucial step towards developing a SABRE-powered flight vehicle that can reach low-Earth orbit without jettisoning fuel tanks on the way.

Additionally, BAE Systems recently formed new partnership agreements with Williams Grand Prix Engineering and Williams Advanced Engineering, to share technology and skills between engineers working on fast jets and fast cars. Initial collaborations are expected to include work on more intuitive cockpit designs for both fighter pilots and racing car drivers, aerodynamics, thermodynamics and lightweight materials, battery technology, and virtual and augmented reality.

The contribution of BAE Systems to the UK Economy
USING AUGMENTED REALITY TO TRANSFORM NAVAL COMBAT SYSTEMS

Reflecting the increasing use of virtual, mixed and augmented reality systems across the defence sector, BAE Systems is investing £20 million in developing augmented reality (AR) and artificial intelligence (AI) solutions for its combat systems on board naval warships. These innovations are designed to support naval personnel in increasingly complex operational scenarios and respond effectively to diverse threats.

For example, wearable AR glasses will allow officers outside operations rooms to see tactical situation data and other vital information from anywhere on the ship. When used on the bridge of a ship the locations of vessels could be overlaid on a real-world view, enabling officers to prioritise and respond more quickly and reach crucial decisions faster. AI can be used to pinpoint the most important information in a given situation, then recommend appropriate courses of action.

Furthermore, BAE Systems is developing a new standard for its combat systems fitted on Royal Navy vessels. “Shared infrastructure” uses standardised computer consoles and open-architecture software to maximise the ease with which components can be added, upgraded, and replaced. This is an evolution of the previous approach of running bespoke operations rooms on proprietary software and hardware and provides a more flexible approach that is expected to generate cost savings.

The technology works in a similar way to consumer “app stores”, allowing crews to quickly reconfigure a ship’s combat systems to suit the requirements of different operations, from mine disposal to humanitarian missions. In addition, the software runs on high-bandwidth networks connected to large server farms for added resilience against damage or failure.

According to Frank Cotton, Head of Technology for the Combat Systems unit at BAE Systems, these new technologies “have the potential to transform maritime warfare, and greatly increase the efficiency of crews on board Royal Navy ships”.

The AR technology projects in BAE Systems’ Maritime business are run in parallel with mixed reality techniques utilised by the Company’s engineers in developing “wearable” future cockpits for military aircraft. The wearable cockpit leverages the adaptability of the Striker II helmet-mounted display (HMD) from BAE Systems’ Electronic Systems business in Rochester, Kent. The full-colour HMD replaces current physical cockpit layouts by projecting augmented and virtual reality interactive cockpit displays and controls directly in front of the pilot’s eyes.

BAE Systems engineers are also introducing AI aids into warship combat systems, allowing users to process data more quickly and reach crucial decisions faster. AI can be used to pinpoint the most important information in a given situation, then recommend appropriate courses of action.

In addition, BAE Systems stimulates economic activity, employment, and tax contributions through other parts of the economy. The procurement spending of the Company’s UK operations supports activity through its network of direct suppliers, who in turn buy products and services from their own supply chain. The employees of BAE Systems and those in its supply chain also spend their wages at consumer-facing businesses around the UK, helping to support further business activity.

In total, we estimate that BAE Systems’ operations in the UK contributed £9.3 billion in gross value added in 2018. This economic activity supported 124,000 jobs in total and generated £2.4 billion of tax revenues for the UK Exchequer.

6. CONCLUSION

BAE Systems makes a major contribution to the UK economy through many channels, beginning with its direct operations that support employee jobs and generate shareholder profit and tax contributions.

In addition, BAE Systems stimulates economic activity, employment, and tax contributions through other parts of the economy. The procurement spending of the Company’s UK operations supports activity through its network of direct suppliers, who in turn buy products and services from their own supply chain. The employees of BAE Systems and those in its supply chain also spend their wages at consumer-facing businesses around the UK, helping to support further business activity.

In total, we estimate that BAE Systems’ operations in the UK contributed £9.3 billion in gross value added in 2018. This economic activity supported 124,000 jobs in total and generated £2.4 billion of tax revenues for the UK Exchequer.

However, these figures do not reflect the full extent of the Company’s impact on the UK economy. BAE Systems’ activities include many aspects from which further long-term, but less directly quantifiable, benefits would accrue to the UK. These include:

• investment in capital equipment and facilities;
• innovation through R&D spending;
• investment in university collaborations;
• training schemes for employees and apprentices, and education schemes for school children;
• generating export demand for the economy; and
• fostering closer working relationships with other governments.

The multitude of long-term contributions made by this major manufacturing employer are crucial to the growth of the UK economy in the years ahead—particularly as the nature of the country’s relationships with the EU and the rest of the world changes.

Activities such as BAE Systems’ Maritime business are run in parallel with mixed reality techniques utilised by the Company’s engineers in developing “wearable” future cockpits for military aircraft. The wearable cockpit leverages the adaptability of the Striker II helmet-mounted display (HMD) from BAE Systems’ Electronic Systems business in Rochester, Kent. The full-colour HMD replaces current physical cockpit layouts by projecting augmented and virtual reality interactive cockpit displays and controls directly in front of the pilot’s eyes.
APPENDIX A: DETAILED LOCAL FINDINGS

ECONOMIC IMPACT OF BAE SYSTEMS ON LOCAL AREAS

Fig. 15: BAE Systems’ 2018 procurement spend and number of suppliers, top 25 parliamentary constituencies by value of spend

<table>
<thead>
<tr>
<th>Rank by spend</th>
<th>Parliamentary constituency</th>
<th>Procurement spend, £m</th>
<th>Count of suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Stevenage</td>
<td>240</td>
<td>26</td>
</tr>
<tr>
<td>2</td>
<td>Edinburgh North and Leith</td>
<td>200</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>Luton South</td>
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<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Cities of London and Westminster</td>
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<td>14</td>
</tr>
<tr>
<td>5</td>
<td>Salford and Eccles</td>
<td>150</td>
<td>14</td>
</tr>
<tr>
<td>6</td>
<td>Basildon and Billericay</td>
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<td>Filton and Bradley Stoke</td>
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<td>12</td>
<td>Meon Valley</td>
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<td>10</td>
</tr>
<tr>
<td>13</td>
<td>Barrow and Furness</td>
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<td>Eastleigh</td>
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<td>25</td>
<td>Sheffield Central</td>
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Fig. 16: BAE Systems’ FTE employees by parliamentary constituency of residence, 2018, top 25 constituencies

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<th>Rank</th>
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<th>FTEs</th>
</tr>
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<tbody>
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<td>Fylde</td>
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<td>3</td>
<td>Wyre and Preston North</td>
<td>1,160</td>
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<tr>
<td>21</td>
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<tr>
<td>23</td>
<td>Glasgow North West</td>
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<tr>
<td>24</td>
<td>Copeland</td>
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<tr>
<td>25</td>
<td>Lancaster and Fleetwood</td>
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</table>
The contribution of BAE Systems to the UK Economy

Fig. 17: Major BAE Systems sites with more than 100 FTE staff in 2018

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<th>Rank by FTEs</th>
<th>Worksite</th>
<th>FTEs</th>
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<tr>
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</tbody>
</table>

Jane, a manufacturing graduate in BAE Systems’ Air business.
APPENDIX B: ECONOMIC IMPACT METHODOLOGY

ECONOMIC IMPACT MODELLING

Economic impact modelling is a standard tool used to quantify the economic contribution of an investment or a company. Impact analysis traces the economic contribution of an investment through three separate channels:

- **Direct impact** – refers to activity conducted directly by BAE Systems in the UK.
- **Indirect impact** – consists of activity that is supported as a result of the procurement of goods and services by BAE Systems in the UK, purchases by those companies in turn, and so on.
- **Induced impact** – reflects activity supported by the spending of wage income by direct and indirect employees.

**Fig. 18: Direct, indirect, induced and total economic impacts**

Direct impacts

The direct value added of BAE Systems is calculated as revenues minus the cost of goods brought in. Value added per employee, a measure of productivity, is a figure derived from dividing direct value added by the number of FTE employees.

Indirect and induced impacts

Indirect and induced impacts are estimated using an input-output model. An input-output model gives a snapshot of an economy at any point in time. The model shows the major spending flows from “final demand” (i.e. consumer spending, government spending, investment and exports to the rest of the world); intermediate spending patterns (i.e. what each sector buys from every other sector—the supply chain, in other words); how much of that spending stays within the economy; and the distribution of income between employment and other forms such as corporate profits. As these models measure activity within an economy, the direct impact figures will often not match company annual accounts, which follow accounting standards and rules.

An input-output model uses a matrix representation of a nation’s interconnected economy to calculate the effect of changes by consumers, by an industry, or by others, on the economy as a whole. These input-output tables ultimately measure “multiplier effects” of an industry by tracing the effects of its inter-industry transactions—that is, the value of goods and services that are needed (inputs) to produce each pound of output for the individual sector being studied. These models can be used to measure the relationship between an economic change or “shock” and the final outcome across the whole of the economy.

In essence, an input-output model is a table which shows who buys what from whom in the economy.

Oxford Economics used the input-output table for the United Kingdom for 2015, published by the ONS in 2019, for this analysis. This is the most recent input-output table for the United Kingdom.

The multipliers quoted in the report represent the multiple of direct impacts that account for total impacts. For instance, if 20 FTE jobs were direct impacts and the total impact multiplier was 2, then the total impact would be 40 FTE jobs. These multipliers are calculated from the input-output model results.

Indirect jobs are presented including the contingent labour or contractors that BAE Systems hires. Data on these workers is obtained from the Company’s HR systems, and spending on these workers from the Company’s procurement systems. We assume that 10 percent of the spending on these workers is retained by employment agencies, while the rest is added to the Company’s indirect GVA contribution.

Industry breakdowns

The UK 2015 input-output table is divided into 105 different industry sectors, and the table shows how each sector interacts with the 104 other sectors. For purposes of illustration to show value added and employment supported across different sectors, the 105 different industries have been pooled into broad industry categories in this report. For example, the professional services industry amalgamates the following sectors:

- Legal services
- Accounting, bookkeeping and auditing services; tax consulting services
- Services of head offices; management consulting services
- Architectural and engineering services; technical testing and analysis services
- Scientific research and development services
- Advertising and market research services
- Other professional, scientific and technical services
Oxford Economics was founded in 1981 as a commercial venture with Oxford University’s business college to provide economic forecasting and modelling to UK companies and financial institutions expanding abroad. Since then, we have become one of the world’s foremost independent global advisory firms, providing reports, forecasts and analytical tools on more than 200 countries, 250 industrial sectors, and 7,000 cities and regions. Our best-of-class global economic and industry models and analytical tools give us an unparalleled ability to forecast external market trends and assess their economic, social and business impact.

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September 2019
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The modelling and results presented here are based on information provided by third parties, upon which Oxford Economics has relied in producing its report and forecasts in good faith. Any subsequent revision or update of those data will affect the assessments and projections shown.

To discuss the report further please contact:

Rob Harbron, Associate Director:
rharbron@oxfordeconomics.com
Oxford Economics,
4 Millbank,
Westminster,
London,
SW1P 3JA
Tel: +44 (0)20 3910 8000
www.oxfordeconomics.com

Russell, a BAE Systems Maritime employee from Portsmouth, during UK trials for the 2020 Invictus Games. BAE Systems is a presenting partner of Invictus UK.